2015

Boyce Worthley Oration. 'Drawing the line': A risk communication perspective

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Publication Details

Croft, R. J. (2015). Boyce Worthley Oration. 'Drawing the line': A risk communication perspective. Radiation Protection in Australasia, 32 (2), 2-10.

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Keywords

line, risk, communication, perspective, worthley, boyce, oration, drawing

Disciplines

Education | Social and Behavioral Sciences

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BOYCE WORTHLEY ORATION

'Drawing the line': A risk communication perspective

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Submitted 9 November 2015; accepted 10 November 2015

ABSTRACT

The paper represents a text version of the Australian Radiation Protection Society's Boyce Worthley Oration, which I had the privilege of delivering in 2014. The purpose of the presentation was to address the issue of whether, from a risk communication perspective, enough radiation protection research had been conducted and it was time to 'draw the line'. The paper addresses this issue by focusing on the radiofrequency (RF) risk communication domain, but is also applicable to radiation protection more generally. It first provides a brief overview of both community concern about RF and the relative support from science regarding this concern, where it is argued that the science does not provide support for such concern. It then looks at some of the reasons for this discrepancy, and argues that it is due to the very complex, very 'normal' ways that humans process information and create meaning from it, but which consequently also leads to error and limits the applicability of specific communication strategies to the community more generally. Drawing the above conclusions together the paper then argues that regardless of how certain RF health research outcomes are or could in principle be in the future, there will remain a strong need to adapt to the complexity of people's interpretation of the science, and that this will necessitate both further RF risk communication and RF basic science research; it concludes that no line can be drawn. On a more positive note the paper also looks at what risk communication is doing in the RF domain, and provides some practical advice aimed at improving risk communication outcomes.

PROLOGUE

It was a great honour to be invited to deliver the Australian Radiation Protection Society's (ARPS) 2014 Boyce Worthley Oration, and in particular to be associated with someone who has contributed to the radiation safety domain in such a sustained and community-centred manner. I felt too that the task I was given was particularly appropriate given Worthley's lifelong contribution to the area, as it was an opportunity to pause and consider whether it was time, in terms of radiofrequency (RF) electromagnetic radiation research, to draw the line; or in other words to check whether further research effort would benefit society, rather than being merely an academic exercise. As a risk communication perspective, this will be addressed via detailed consideration of risk communication itself, but as will be seen in the final section, the answer to this has direct ramifications for RF health research more generally. It should also be noted that although focusing on RF, the discussion and conclusions drawn are also directly relevant to radiation protection more generally.

The present paper represents an attempt to communicate, in manuscript format, the 2014 Boyce Worthley Oration which addressed this issue. As the Oration was provided in the form of a conversation-like presentation to discussion with the 2014 ARPS delegates, I clearly run the risk of mixing formats and confusing the message that I hope to communicate. I will thus attempt to follow the narrative of the Oration as far as practicable, which I hope the reader will understand may result

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in less 'detail' than might otherwise be expected in a journal paper, as well as necessitate changes to the structure of the presentation in order to capture the essence of it.

RF HEALTH AND COMMUNITY CONCERN – *WHAT'S THE PROBLEM?*

With the growing use of RF-based technologies, ranging from mobile phones, base stations, wi-fi and smart metres to product identification scanners and even wireless baby monitors, RF is omnipresent in today's society. RF exposure is not new. However, while more traditional sources of RF (such as FM radio) tend to be viewed as benign by the community, there has been strong community concern that these newer RF technologies are causing harm. This concern relates to a wide range of health effects, from annoying sensations on the skin, to potentially fatal diseases such as cancer. Accordingly the degree of concern can vary greatly, from a theoretical belief that has little or no impact on daily life, to complete preoccupation with the RF 'threat'. In the latter case, this has led to some removing themselves from what they perceive as the 'RF world', including sacrificing employment and domicile, to move to a location, typically rural, which is thought to have lower RF emissions.

It is difficult to determine how widespread this concern is in the community, nor how strong. A number of surveys have been conducted to obtain data on the matter, but in order to provide adequate representation of the community the questions have had to be brief and relatively crude. However, as an indication, a Special Eurobarometer report on electromagnetic fields in 2010 found that 33% of respondents reported that mobile phone base stations affected their health 'to a large extent', with values ranging from 79% in Italy to 6% in Finland[1]. This does not necessarily mean that the 6-79% believe that RF impacts *importantly* on their lives, but it does provide an indication that a large number of people believe, at least from a theoretical perspective, that RF is indeed harmful.

This concern is highlighted in the 'news' media, with reports often suggesting that technologies such as mobile phones and base stations cause a range of health issues. For example, in relation to what is often referred to as Electromagnetic Hypersensitivity (EHS; a condition whereby people 'report' being adversely affected by RF), the majority of media reports have claimed that RF indeed causes the symptoms[2]. It is also increasingly common to see community actions designed to restrict RF exposure beyond the restrictions imposed by governmental regulation (for example "Stop Smart Meters"[3] and "No Towers Near Schools"[4] are community organisations in Australia developed for this purpose), and although rare, it is becoming more common to see law suits that attempt to obtain financial compensation for health issues that are claimed to be caused by RF exposure (e.g. McDonald versus Comcare[5]). Particularly given the large number of RF emitting devices in the modern world, if such claims are correct, this would represent an important health effect requiring not only the reconsideration of governmental regulation, but also unambiguous communication of such risks.

THE SCIENTIFIC LITERATURE ON RF AND HEALTH – *IS THE PUBLIC CONCERN JUSTIFIED?*

However, when we consider the scientific literature addressing the issue of potential health effects from 'low level' RF (i.e. of or below the magnitude typically encountered from mobile telecommunication devices), the above concern is not supported. There are of course a range of views in science, but there is strong consistency across the World Health Organisation, the International Commission on Non-Ionising Radiation Protection (ICNIRP) and the International Association of Electronic and Electrical Engineers (IEEE), with the latter two the only international RF Guidelines/Standards setting bodies. Their determinations are that there is no established evidence of harm resulting from low-level RF exposure. I view these as the most qualified and appropriate groups to evaluate this complex issue, and the consistency of their evaluations, in conjunction with my own reading of the literature, provides me with strong confidence in their conclusions.

I will not deal with the RF health literature directly, but given that there are a range of community and academic members who argue that the ICNIRP Guidelines and IEEE Standards are flawed, it is important to highlight some of the reasons given for this view, as well as my reasons for not finding those arguments cogent. As far as I am aware, the main reasons given for criticising these Guidelines/Standards are: (1) The guidelines do not take into account non-thermal effects of RF; (2) The guidelines do not take into account cumulative RF exposure (but rather only consider acute exposures); and (3) The guidelines do not evaluate the literature adequately.

I do not agree with these views, and in support of my perspective would note the following with reference to the ICNIRP (RF) Guidelines (of which I have greatest experience with):

1. Although the majority of RF-induced health effects identified in the guidelines are thought to be thermally mediated, the guidelines consider all health effects. Indeed although mechanistic knowledge is very useful, the guidelines are not dependent on such knowledge – they consider all established health effects caused by RF, and specify exposure levels so as to avoid them;

2. The Guidelines do in fact take into account potential effects of chronic exposure. However, as it is difficult to look at chronic exposure experimentally in humans, the research has had to extrapolate from epidemiological data in humans and experimental designs in non-humans (typically rodents and non-human primates), with no health effects demonstrated (beyond those at high RF levels observed acutely); and

3. My personal experience with both ICNIRP and IEEE is that they provide very considered and appropriate evaluations of the literature. Indeed the claims made and evidence proffered by those with competing views are also considered by ICNIRP and IEEE, and, depending on its quality, form part of the evidence base that the guidelines are derived from. The following discussion is thus predicated on the assertion that there is solid scientific consensus that low-level RF exposure, of or below the magnitude encountered from typical telecommunications devices such as mobile phones and base stations, does not cause harm.

RF HEALTH AND RISK COMMUNICATION – *WHAT ROLE DOES RISK COMMUNICATION PLAY?*

From the previous two sections a clear disconnect can be seen; there is strong community concern that low-level RF is harmful, and yet the scientific consensus does not support this view. So what is the role for risk communication in such a scenario? At this point we begin to diverge from the objectivity of science and need to incorporate values. That is, risk communication is the science of communicating, the science of altering cognitions and/or behaviours, but it relies on others to specify the target cognitions and/or behaviours. It follows that in different scenarios risk communication will be attempting to achieve very different objectives – engaged by one group the communicator may be attempting to make the community more concerned about the 'dangers' of RF, and by another they may be trying to allay fears of RF. Further, although the motivations of those dictating the target cognitions and/or behaviours can vary substantially (in both of the above scenarios it may range from selfish to altruistic), such motivations are not the domain of the communicator.

For the present audience though an altruistic motivation is assumed, such as would be expected from a public health department, where the communicator is tasked with producing a more realistic appraisal of (and behaviours consistent with) the relative risk of RF within the community, so as to both maintain health and avoid unjustified concern. The role of the risk communicator would therefore be to employ the communication methods of the profession to achieve, as far as possible, this end. I take this to be a very standard view within the radiation protection community, indeed it is difficult to imagine there being any disagreement over this approach. The problem is that given that this approach is currently being employed both here in Australia and internationally, and given the 'disconnect' between community concern and scientific consensus described above, this approach is not working as effectively as we would like.

LIMITATIONS TO THE RISK COMMUNICATION PROCESS – *WHY THE DISCONNECT?*

I would argue that there are two primary reasons for this failure, which I refer to as: (1) S*emantics*, or the hidden (and inherent) difficulty of framing a simple unambiguous statement; and (2) *Complexity*, or the manner in which humans incorporate information and manufacture meaning from it. Before addressing each of these it is important to take a step back and look at what how risk communication has traditionally been seen as, as this is the approach that I would argue is currently engaged for RF risk communication.

In general terms, the 'traditional' risk communication model posits that once science has reached an unambiguous conclusion, that provision of evidence supporting that conclusion is all that is required to generate the appropriate cognitions and/or behaviours in the target audience. There is a vast literature dealing with the limitations of this view in terms of risk communication more generally, and correspondingly numerous models that provide communication methods that lead more effectively to the desired cognitions and/or behaviours (see [6]). While much of that generic literature has bearing on the above disconnect between science and perception, I will here focus on two particular issues in relation to the case of RF health communication. Specifically, I will address the assumptions that science has unambiguous conclusions to communicate, and that an intelligent and unbiased recipient will understand the message as intended. This, I hope, will identify the most salient issues that we need to consider in terms of NIR risk communication.

1. Semantics

It is typically assumed that given *sufficient* scientific investigation (and evaluation of that investigation), science will reach an unambiguous determination that can then be communicated. Let us assume that such an unambiguous scientific determination has been reached in relation to RF-Health. The question then becomes 'How do we frame that determination to make it suitable for communication?' At first sight this might appear simple, and we may arrive at a conclusion such as 'low-level RF exposure does not affect health' (or depending on how conclusive we think it is we may water this down using various qualifiers). Let us assume that the research ***is*** very conclusive though, as this will make it easier to see the semantic difficulties that the scientist-communicator faces.

There are a number of interpretations that even this statement could rationally result in. For example, strictly speaking it is an ontological statement, commenting on what exists (as opposed to what we know), and as has been demonstrated by such greats as Descartes and Hume, we are not justified in making such statements as we could be 'being deceived by a malignant demon' or merely 'dreaming' that the statement is correct. Thus for the recipient with a philosophical background, the statement may raise doubts because it is saying something that they not only believe is false (i.e. that we can be certain of what exists), but that the philosophical literature also provides strong support for. Unfortunately the situation is not resolved by restricting the intention to epistemology, where there is less focus on 'what exists' and more on 'justified belief' as to what exists, as the same arguments can be used to conclude that no beliefs can be adequately justified.

We may decide though to look at the issue in terms of what the scientist is more familiar with. That is, assuming that such difficulties are 'merely philosophical' and deciding how we can frame our determination in terms of such issues as consistency of results, appropriateness of the methodologies used to obtain those results, and ideally the degree to which we understand the mechanisms responsible for any RF-health relations. However, this is equally problematic in terms of providing a clear statement with which to communicate. For example, if we are to say that 'there is no evidence that low-level RF affects health', questions arise as to what we mean by 'evidence' and the causal nature of 'affects'. ICNIRP, for instance, looks for 'established' evidence when setting Guidelines, which is typically based on independently replicated effects with adequate methodology, and so there is nothing inconsistent between the above statement based on this interpretation, and another person asserting that there is evidence that low-level RF does affect health (in the sense of there being one study that asserts that there is such evidence, regardless of methodological adequacy or consistency with other research outcomes). So even seemingly simple terms like 'evidence' can be interpreted in very different ways, making the notion of designing simple statements to communicate our determination highly problematic.

Although this may appear to be 'only semantics', this confusion between the two meanings of 'evidence' is indeed an issue that I often face when trying to communicate with community members that are very fearful due to what they interpret as *evidence* that low-level RF harms people (and their extrapolation to the view that standards setting bodies such as ARPANSA and ICNIRP must be disingenuous in their conclusions). Unfortunately this semantic issue is ubiquitous in science, as highlighted recently by the classification of RF as a Class 2b Carcinogen by the International Association for Research into Cancer (IARC). IARC expands on this classification by referring to it as 'possibly carcinogenic', and so although appearing to provide a less technical and potentially confusing classification, it raises substantial questions concerning the meaning of 'possibly'. Indeed recent research attempting to determine how people interpret the 'possibly carcinogenic' classification suggests that it is highly variable and generally misunderstood, and that to remedy the situation greater emphasis on narrative is required[7]. This research suggests that greater complexity in the statement is needed to produce the desired interpretation (for example, by providing context to help understand what is meant by 'possibly carcinogenic', such as through comparisons with other agents classified as possibly carcinogenic that the target audience would be familiar with, such as ‘coffee’), and thus that we need to move ‘away from’ the simple statements that we were originally trying to find, as they are far from unambiguous.

So even relatively concise, focused, scientific summary statements may not be interpreted as intended, and given that as we extend the summary narrative to provide greater explanation we are also increasing the number of potentially ambiguous words and phrases, it is clear that designing our scientific statements is a challenging task in its own right.

2. Complexity

So why is it so difficult to communicate what we would think of as simple clear statements, particularly given that a computer program could easily be written to deal reliably with such input statements? The answer to this is often described in a pejorative sense, where humanity as a whole is seen as irrational, biased and flawed. Personally I see this as a misunderstanding of human nature, and rather would emphasise that these ‘weaknesses’ can equally be seen as strengths that have been extremely effective in an evolutionary sense, and that our difficulty communicating such simple statements is in many ways due to the sophistication or complexity of our cognitive and affective processes. These are normal processes that benefit even the most rational of scientists, and I believe it is worth emphasising a small portion of this complexity in order to better appreciate the difficulty of communication.

For example if we consider, even crudely, the information processing steps required to be cognisant of our ‘simple’ (written) scientific statement, we see immediately that it is far from simple. It is perhaps easiest to think of these processes in terms of a number of discrete linear steps. For example, as we read the above statement, light reflected from the letters (and background) strikes the retina before passing through the optic nerve to the occipital cortex of the brain. Here it undergoes a number of sequential processes that extract features from the visual data until sufficient to enable it to be matched against stored representations of letters and words. Algorithms are then employed to make grammatical sense of these letters and words, and finally meaning must be interpolated via comparison with stored knowledge/belief of the world more generally. However, the simple linear framework is an important oversimplification. For example: (1) Even at the level of the retina there are dynamic (and imperfect) processes operating that inhibit some and facilitate other aspects of the visual stimulation, so as to enhance the signal to noise ratio and improve the chances of accurate uptake of the text; (2) Similar modulating influences operate at the level of the occipital cortex (prior to the text being identified as letters), with these biased by factors such as emotional state; and (3) At higher levels of processing, once letters have been identified (or to be more accurate, interpreted from the visual stimulation) and grammatical structure is being discerned, similar modulatory processes operate that are influenced by relatively concrete non-conscious beliefs such as expected frequencies of grammatical marks (e.g. within a given grammatical context, is ‘.’ or ‘,’ more likely), as well as by conscious and non-conscious expectations as to the likely meaning of the text. In other words, there is plenty of opportunity for both conscious and non-conscious processes to change ‘low-level RF exposure does not affect health’ to ‘low-level RF exposure does affect health’; after all, the human brain has over a billion neurons (and over 10 trillion interconnections between them) which shape the data arriving at the senses into meaningful interpretations that fit within a lifetime’s experience of other such interpretations.

Of course as professionals we would then check that our interpretation of the statement was consistent with the remaining text, perhaps we would re-read it, and we would consider whether our interpretation was consistent with other beliefs that we have on the matter, and this would provide an opportunity to test our original interpretation and update it accordingly. This is a time-consuming and effortful process though, and not something that would be expected from the community recipient of a risk communication message. Particularly as we move from the ‘relatively’ simple text to complex statements of meaning, there is ample opportunity for unintended interpretations of our message. A common example of this was given above in relation to the word ‘evidence’, such that the statement ‘there is no evidence that low-level RF exposure affects health’, could easily be interpreted as meaning that there is not one study that has reported such an effect, based not on the text, but on prior experience that has led to the belief that one such report ‘is’ evidence. This could then rationally lead to suspicion about the adequacy of the body providing the statement. Importantly, this is ‘rational’ in the sense of making logical conclusions based on premises (or previous states of belief), rather than suggesting that an accurate belief has been reached.

As well as being a potential source of error, this constant attempt by the brain to interpret and modify incoming data is a crucial part of what has made humans successful. That is, it is not only a way to help separate signal from noise, but it also allows for very rapid responses that would not otherwise be possible. For example if you surprised an aggressive tiger in the wild, there would not be sufficient time to process all of its features in time to avoid the danger. However, by sacrificing accuracy for speed we can enable fast decisions (e.g. "large + orange + in-environment-with-tigers = run"); emotional bias plays a large role here, as mistaking a *large toy* for a *tiger* is less likely an issue than mistaking a *tiger* for a *large toy*, and so our experience-based emotional responses help steer (in this case) our response towards avoidance (as opposed to approach) behaviours.

Similarly, heuristics, or mental shortcuts that optimise speed/ease of interpretation over accuracy, are used extensively by humans to solve problems and make quick judgements, and for very good reason. As an example, if we were to study the background to all the stories we see on the nightly news in sufficient depth to know whether to believe what we are told, it is likely that we would not have sufficient time to watch the nightly news, let alone sleep. So the use of heuristics is perhaps the only way for us to arrive at workable conclusions about the world, even if necessarily less than accurate. This is of course the same for RF health and safety. The person watching the news and hearing that 'there is no evidence that low-level RF exposure affects health' cannot spend sufficient time researching the literature to know whether this statement is correct, and so has to rely on heuristics that will necessarily differ from one person to another. One person might be guided by the heuristic that the news is always accurate, while another might be guided by the view that all RF expert bodies are controlled by industry, with the resultant interpretations likely to be antithetical.

People thus utilise heuristics extensively to make sense of the world, and although in general these 'rules of thumb' are greatly beneficial, a necessary consequence of their use is that we make many many mistakes as well. What is particularly problematic is that as the heuristics are heavily dependent on personal experience (in addition to biology), whoever controls our experience has the opportunity to make them more or less likely to result in accurate determinations. For example if the media or our social circle encourages a particular heuristic, such as scepticism towards radiation protection bodies, then this will shape our heuristic (such as by making it more difficult for our simple scientific statement to be believed).

FROM CONFUSION TO RISK COMMUNICATION – *DEALING WITH COMPLEX SCENARIOS*

So, given the inherent difficulties of trying to make unambiguous scientific statements as well as dealing with the vastly different ways that people interpret these statements, what can be done to increase the alignment between message and resultant belief? This is where social science plays its role. Given the complexity of the message-belief relation within an individual, and given that this complexity is interacting with that of our social environment (or the interactions of the interactions of the individuals), social science is never going to be in a position to completely determine this realm. However, just as the individual does, it can develop 'rules of thumb' or heuristics that can improve the predictability of the message-belief relation.

At this point it may be useful to consider the Social Amplification of Risk Framework (SARF), as it offers one such heuristic that helps us understand the difficulty of improving the message-belief relation. It differs of course from the natural sciences in that there is greater variability and thus less predictive ability, and in particular its 'elements' (people) and 'relations' (social context) are constantly evolving, but as per natural science it attempts to identify laws that will, to a greater or lesser extent, allow prediction.

SARF in many ways parallels the message-belief processing stages of the individual that were described above, but does so by incorporating what we know about both the individual's method of deriving knowledge, and that of their social environment. That is, it posits a cyclic process whereby various types of intra-individual and social influences will either amplify of attenuate perceived risk, with the outcome of such processes then playing a role in the next amplification/attenuation stage relating to other types of intra-individual and social influences. The task of risk communication in this case is thus to identify the factors that work to amplify or attenuate the perception of risk, and use this information to help anticipate the consequences of a particular statement, or ideally to help develop methods to interface with these determinants of risk perception to increase the chances of the desired outcome (i.e. belief that is consistent with the scientists' determination).

Bringing this back to the scientists' determination that 'low-level RF does not affect health', this approach may identify, for example, that the actual scientific statement does not play a major role in determining the recipient's subsequent belief, but rather that other non-science information does, such as information about conflicts of interest. Instead of focusing a risk communication message on the scientific outcome, it may thus dedicate the majority of the message to the issue of 'conflict of interest', with the scientific statement representing only a minor part. Similarly, it may identify that within a particular culture, the similarity of RF to other more familiar agents is an important factor in helping the person interpret the science, and so greater comparative information may be emphasised, such as by explaining that coffee and RF are in the same IARC 2b category, or by explaining that RF is what FM radio transmissions have been using for many years.

CUTTING THROUGH THE LIMITATIONS – *SOME PRACTICAL RISK COMMUNICATION ADVICE!*

As suggested by the last section, the complexity involved with moving from a message to a belief is substantial, and no simply recipe can be provided. However, a number of factors have been identified that impact the way in which a message will be interpreted, and this knowledge provides sound principles with which to approach risk communication that will improve the chances of the message recipient's belief matching the scientists' determination. Here I briefly describe one such set of recommendations that are based on solid theoretical understanding of how people generate beliefs, have direct applicability to the implementation of RF risk communication, and that are empirically supported. This was developed recently by Wiedemann and colleagues and is referred to as the 'Credibility of Risk Assessment' (CORA) framework[8].

In essence, this framework treats the message recipient as an active agent trying to decide whether to adopt the intended message, and emphasises in the communication the (empirically-determined) issues that best enable the recipient to make such a determination. The framework emphasises six categories of information that need to be included in any risk communication: Overview (or background information); Accountability (the mandate of the group making the scientific statements, as well as their funding sources); Expertise and impartiality (the composition of the expert group, how it was selected and how impartiality was assured); Adherence with good scientific practices (the procedure for arriving at the conclusion, including how consensus was determined); Consultation and participation (procedures for accounting for conflicting views of those outside of the expert group); and Adherence with good reporting practice (balanced discussion of the evidence, clear linkage between the evidence and conclusions, uncertainty reported, and a plain language summary).

To me these are the same things that we as scientists or radiation safety professionals would be looking for when evaluating a risk communication (assuming that we weren't planning on spending a few weeks reading the original literature itself), and so I see the framework as providing strong face validity. However it is noteworthy that few radiation protection messages provide this information, but instead focus more on the science itself. Indeed one of the functions of the CORA framework is as an evaluation tool for risk communication messages more generally, providing an opportunity to see whether information that is important to the message recipient has been omitted. Of course this framework does not ensure that the recipient will adopt the *intended* message, but rather it gives the recipient the opportunity to evaluate it effectively and reach a more reasonable determination. For example if the science underlying the determination that 'there is no evidence that low-level RF affects health' did indeed use poor methodologies, was not equipped to deal with conflicting views or was biased, then it would be reasonable to reject the *intended* message. In my view however, that would be a good outcome and testament to the success of the framework.

In addition to this I would emphasise the importance of communicating proactively. Given the effect of pre-existing beliefs on how we process new information (see above), it is particularly difficult for the message, no matter how well communicated it is, to allow the recipient to make a reasonable judgement if they have already taken the contra position. This is why, for example, certain information is suppressed by a court prior to a trial, as it is acknowledged that the way that it is presented in the media can make it difficult for a jury to arrive at a reasonable conclusion. In many ways it thus makes sense to focus communication on those who have not already committed themselves to strong positions. Working with schools and the community more generally represent great opportunities to provide the information required to help people make informed decisions about risk, whereas communication is unlikely to be useful where strong bias (justified or otherwise) is present.

Thus in terms of practical advice for risk communication, although there is great complexity in the way that information will be processed by the message recipient, I would suggest that the following simple steps will greatly enhance the process:

- Approach the task by viewing risk communication as an endeavour to improve people's understanding of the science, rather than as a way of passing on facts;

- Treat the communication recipient as an active agent trying to make sense of the information, rather than someone whose beliefs need to be changed. If we believe that our processes of determining the message that we want to communicate are sound, we should view risk communication as an attempt to provide the communication recipient with an opportunity to consider the same steps of logic;

- Use a strong framework, such as CORA, to ensure that the issues that most people view as important are appropriately dealt with. Just as heuristics provide tangible benefits to humans, such frameworks (where supported by evidence) can be viewed as heuristics that improve our ability to link science with the community;

- Be proactive!

DRAWING THE LINE – *A RISK COMMUNICATION PERSPECTIVE!*

Having described in detail the difficulties associated with communicating the relative risks associated with RF (as well as some methods to improve this communication), we can now consider whether it is time to draw the line, to conclude that further RF health research will not be of use to the community. Drawing upon the discussion above, we can now conclude the following:

1. *The RF-Health research to date is not sufficient to allay the fears of the community.*

   As argued above, this is not surprising given that, regardless of how conclusive this research might be on a scientific level, scientific knowledge accounts for only a small portion of the perceptions of the community. Thus even if substantially stronger conclusions could be reached regarding RF and health, this would not satisfy the community.

2. *The RF-Health risk communication research is not sufficient to allay the fears of the community.*

   As argued above, the way that humans derive meaning from data is exceedingly complex, and at least in the foreseeable future, will not be sufficiently determined (and controlled) to enable science to effectively communicate its findings to the community. Thus although risk communication can improve the situation and increase the number of people whose beliefs match the determinations of science, it is inconceivable that it could remove the 'disconnect' between scientific determinations and community perceptions. Thus the community will continue to demand further scientific investigation of the RF-Health domain, independent of the scientific determinations themselves.

3. *There is no line that can sensibly be drawn in terms of health or risk communication research.*

   From a risk communication perspective it is relatively easy to see that our work will never be complete (and thus that no 'risk communication' line can be drawn), but although less obvious from a health research perspective, I would argue that the situation is the same. This is because we are trying to answer the community's desire for better understanding of potential radiation risks, and it is not clear that it is for us (as opposed to the community) to draw such a line. For certain simple issues this may not be the case, such as if the community wanted to know which of two mountains had the highest peak, then having determined this unambiguously, regardless of how many ways it was re-asked or pressure put on the scientist, there would be nothing further that the scientist could offer.

However this is not the situation that we are faced with, and the only way that the scientist can decide to draw the line is via value judgements that go outside their domain of expertise. For example in the case of community concern that 'long-term low-level RF exposure causes cancer', I can draw on science to conclude that the experimental animal and epidemiological human research has been strong, that there is no 'positive evidence' that chronic RF exposure could potentially cause cancer or that the extrapolation from animals to humans was insufficient, and thus I would personally take the view that it is sufficient to stop and draw a line under RF cancer research. The problem is that the last step (concluding sufficiency) is not scientific, it is a value judgement. Indeed it is an axiom of our research that we can never prove the null hypothesis, and so a value judgement is necessarily required in order to draw the line.

The question thus is whether it is up to the scientist, or up to the community to make such a value judgement. From a public health perspective we might have a better appreciation of the likelihood of finding something important to public health in the future, or we might be able to decide where it is best to spend the community's resources so as to maximise the number of life-years within the community, but whether this is what the community values is a different matter, and one beyond the expertise of both the RF-health scientist and the risk communicator. Thus it is difficult to see how, except in the limited sense where there is a reference point such as 'to maximise life-years', a line can justifiably be drawn under radiation health research.

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ARPS CONFERENCE SUPPORT POLICY

The ARPS Executive reviewed the Conference Support Policy and approved an updated version of the policy in August 2014.

An application form has also been created to assist with submission and approval of requests for support. The policy outlines eligibility and the level of support that will be offered. Applications must be submitted prior to the conference that a member wishes to attend.

The full policy and application form are available on the ARPS website:
http://www.arps.org.au/?q=content/arps-conference-support-policy-application-form